2002 P00241

PATENT SPECIFICATION

626,249

Convention Date (United States of America): May 23, 1946.

Application Date (In United Kingdom): May 23, 1947. No. 13887/47.

Complete Specification Accepted: July 12, 1949.

Index at acceptance:—Classes 51(i), B11(a1: b1), B12a; and 123(i), E3c.

COMPLETE SPECIFICATION

Improvements in or relating to Closure Means for Openings in Walls of Chambers arranged to Contain Gas under Pressure

We, BABCOCK & WILCOX LIMITED, a British Company, of Babcock House, Farringdon Street, London, E.C.4, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to closure means especially adapted for use in connection with openings in the walls of furnaces or other chambers operating under internal gaseous pressures considerably above atmospheric and requiring access at intervals such that necessity for shutting down and interference with normal working are avoided. The invention may, for example, be applied to boilers of the kind having a combustion chamber together with a communicating gas flow space wherein gases of combustion are utilised mainly for the generation and heating of vapour, or to apparatus in which high pressure gases may be produced for utilisation in processes or as a hot motive gaseous fluid for gas turbines.

In such installations the enclosing walls are often fluid cooled to provide protection from high furnace temperatures and further are preferably made gas-tight throughout to avoid the troublesome and dangerous condition resulting from the ejection of high temperature gases and other products of combustion. When a wall opening is provided through which access may be had to the interior for cleaning or other purposes it is essential that the opening be fitted with closure means suitably constructed and arranged so as to maintain the continuity of the gas-tight wall construction. Further, since it is essential in many instances to gain access to the interior during normal furnace operation, it is highly desirable to arrange in some manner adequately to control or actually to prevent the discharge of hot products of combustion when the door of the closure means is moved to expose the opening.

As disclosed in the specification of co-pending Application No. 27720/46 as open to public inspection under Sect. 91(4) of the Patents Acts and made by the same Applicants, an effective method of restricting the escape of hot combustion gases is through the employment of high velocity jets of air or other gaseous fluid directed in a converging pattern axially of a furnace wall opening.

An object of the invention is to provide an improved arrangement of door and door frame member for sealing or unsealing an opening in a chamber wall.

According to the present invention closure means for an opening in a wall of a chamber, such as a furnace chamber, arranged to operate under internal pressure, is provided with a door frame member for the opening formed at its front end with a seat surface convexly curved about an axis, a door for closing the passage through the door frame member formed with a companionate seat surface curved about an axis which, when the door is in the colsed position, is coincident or substantially coincident with the axis of curvature of the door frame member seat surface, the door being rotatable about an axis so displaced from the latter axis of curvature that, when the door is moved from the closed position, the axis of curvature of the door seat surface has a component of movement in a forward direction, and jet discharge means adapted to discharge elastic fluid in such manner as to limit or prevent, when the door is open, the ejection through the passage of gas from the chamber.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional side elevation of the lower portion of a steam generating unit embodying the invention;

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Figure 2 is a front elevation, partly broken away, of a portion of the structure shown in Figure 1;

Figures 3 and 4 are enlarged side elevations, taken from opposite sides, of a closure means indicated in Figures 1 and 2, Figures 3 showing the door element closed, and Figure 4, partly in section, showing the door element open;

Figure 5 is a front elevation of the assembly shown in Figure 3;

Figure 6 is a plan section taken along the line 6—6 of Figure 3 and including an associated wall structure;

Figure 7 is a vertical section taken along line 7—7 of Figure 5 and including an associated wall structure;

Figure 8 is a front view of the door head element of the assembly, taken along line 8—8 of Figure 7; and

Figure 9 is a fragmentary enlargement, in section, showing the formation of jet holes.

Figures 1 and 2 illustrate the invention as embodied in a vapour generating unit of the construction disclosed in the specification of Patent No. 598,141 granted to the same Applicants, the unit including a cyclone type of primary furnace 10 from which the products of combustion flow into a secondary furnace 12. The walls of both furnaces are lined with wall cooling tubes suitably arranged and connected so as to to provide natural circulation flow paths in parallel with other vapour generating circuits of the unit, the fluid cooled walls being of improved construction enabling the unit to be maintained under relatively high positive internal pressures throughout, as fully disclosed in the specification of Patent No. 598,141.

The cyclone type primary furnace 10 is of horizontally elongated substantially circular cross section and preferably fired by a primary burner 13 arranged coaxially thereof in the outer end wall 14, the burner being of a type suitable for the kind of fuel to be fired which for the present purposes may be assumed to be a crushed or granular fuel, such as bituminous or semi-bituminous coal.

A stream of primary air and coal is delivered at a relatively high positive pressure through the involute curved primary air-coal pipe 15 which opens tangentially into a lower side portion of burner 13, the effective flow area of the pipe and thereby the velocity of the fuel-air stream being controlled by a manually operated control damper 16. The burner is constructed to impart a radial and forward motion to the entering coal-air stream and the whirling stream moves axially of the primary furnace in a helical path along and in contact with the circular wall 17.

Secondary air is admitted to primary furnace 10 through an axially elongated port 18 angularly spaced approximately 180° from the point of entry of the primary air-fuel stream, the secondary air being delivered to the port through a main air duct 19 having its end section fitting into and opening to the port 18, the velocity of air admission being controlled by a series of dampers 21 arranged to maintain the entering secondary air stream at all times along the primary furnace chamber wall.

A circular tertiary air chamber 23 is arranged at the outer end of the burner 13 and a regulable supply of preheated air is delivered thereto through a duct 24 having an involute curved connection to the chamber 23, producing a whirling stream of tertiary air which is directed axially of the burner.

The primary air-fuel stream thus enters the furnace chamber 10 in a high velocity stream whirling in a clockwise direction with an inner core of tertiary air whirling in the same direction. The fuel-air mixture rapidly ignites and the burning stream flows longitudinally of the furnace chamber at a high angular velocity in a film or layer following a helical path along and in close contact with the furnace circumferential wall. The secondary air enters at substantially the same velocity and direction and gradually merges with the burning stream of primary air and fuel, without disrupting the helical flow path of the latter or separating the primary air-fuel stream from the circumferential chamber wall by a layer of secondary air. Combustion is substantially completed in the primary furnace chamber and the resulting hot gases are discharged through the co-axially arranged rearwardly flaring outlet throat 25 which is formed with an angle of flare of approximately 15° to its axis to provide minimum pressure drop therethrough.

According to one method of operation all of the combustion air may be supplied at a high positive pressure, e.g. 40 in. H_2O, to the primary furnace chamber and a decreasing positive pressure maintained throughout the remainder of the unit.

Openings are provided in the walls of the unit, at various locations, through which furnace operations may be observed and, if desired, a lance or other implement inserted to dislodge slag or other accumulations, or an oil burner or other device inserted to initiate the combustion of fuel introduced through pipe 15.

A suitable closure means 26 for one of such openings in the form of an observation and lancing or lighting door assembly, is shown in Figures 3 to 9, as applied

to an opening, such as the opening 27 of Figure 2 formed between curved tubes 28 associated with a front wall portion 29 of a primary furnace 10 adjacent the secondary air inlet port 18. The wall portion 29 includes a metal casing 29a welded to the outer side of wall tubes 28 to provide with other wall portions of similar construction a completely sealed furnace chamber permitting operation at high positive furnace pressures. Doors of the same general type and function may be installed at various other locations such as at 31a in a wall of the primary furnace 10 or at 31b in a wall of the tertiary air chamber 23 and at the circled locations 32a, 32b, etc. in walls of the secondary furnace 12.

The complete door assembly 26 comprises a door frame unit 34 having axially aligned inner and outer end portions or sections 35 and 36 separately connected by circumferentially spaced cap screws 37 and providing a central cylindrical passage 38 in register with a furnace wall opening 27. The inner frame section 35 is secured to the wall casing 29a as by a weld 39 at the perimeter of a hole 41 therein opposite the opening 27 between spaced wall tubes 28. The outer frame section or door head or door seat member 36 is formed with a socket or counterbore recess 42 therein to receive the circular end of the tubular inner frame section 35 and with the interposed gasket 43 to form an annular fluid-tight joint therebetween.

A door or cover 45, to be described in more detail hereinafter, is mounted on the door head 36 for pivotal movement preferably about a horizontal axis, the door having a window 46 therein to permit observation of interior furnace conditions when the door is closed. In order to prevent escape of hot gases and other products of combustion when the door is open for lancing or other operations, provision is made for directing jets of air or other gaseous fluid at high velocity into the frame passage 38 in the direction of the furnace wall opening 27. For this purpose, the frame section 35 is formed with an exterior air manifold 47 extending circumferentially thereof and, radially inwards of the manifold, with a cylindrical sleeve 48 having a series of circumferentially spaced holes or ports 49 therein through which air or other gaseous fluid from the manifold may be directed to form the jets. The inner periphery of the manifold is slotted as at 51 to provide a circumferentially continuous outlet leading to the series of jet holes or ports 49. The inlet to the manifold is provided by a tapped hole 52 to which connection may be made with a pipe 53 leading from a source of air or other gaseous fluid under the required high pressure.

It is to be understood that while Figures 6 and 7 show the frame unit 34 at right angles to wall 29, other angularities may be employed to advantage in certain locations, depending for example on the direction and velocity of gas flow past the inner end of the chamber wall opening 27. In such cases in general, it is desirable to install frame unit 34 so that its longitudinal axis, and thereby the longitudinal axis of the converging jet pattern is directed downstream of gas flow interiorly of the chamber.

The sleeve 48 is removably assembled interiorly of the section 35 within a circumferential recess 54 which terminates in a shoulder 56 at its inner end, the outer diameter of the sleeve providing a sliding fit within the recess 54, the inner diameter of the sleeve conforming to the diameter of the frame passage 38, and the length of the sleeve substantially equalling the axial extent of the recess 54. Thus the outer end of sleeve 48 is flush with the outer end of frame section 35 and abuts the gasket 43, thereby maintaining the sleeve in position and at the same time effecting a seal between the sleeve and wall of recess 54 to prevent discharge of high pressure fluid except through the jet holes 49. Diametrically positioned holes 57 in the sleeve, longitudinally spaced from slot 51, enable the sleeve to be engaged by a suitable tool for convenient withdrawal from frame section 35 for inspection, cleaning, renewal, or for substitution of a sleeve having jet holes of different flow characteristics and/or providing a different number or pattern of jets.

A suitable arrangement of jet holes 49, for a sleeve 48 having an internal diameter of 3⅜ in. for example, may consist of sixteen equally distributed circumferentially spaced holes 49 each of ⅛ in. diameter and inclined to the longitudinal centre line 58 of passage 38 at an angle A of 25° towards the furnace wall end of the sleeve, the resulting conical pattern of jets converging within the frame passage 38 towards a point on the central axis 58 closely adjacent the furnace wall opening 27. The holes 49 are suitably drilled from the outer surface of sleeve 48 where an annular groove 59 of right-angled cross section is formed to provide a conical drilling surface 61 normal to the axes of individual holes. With jet holes of the arrangement and size described, for preventing the ejection of gases from a chamber operating at super-atmospheric pressures up to 40 in. H_2O, for example, the air supplied to manifold

47 is preferably maintained at pressures above 50 pounds per square inch.

In addition to the air introduced at high velocity through jet holes 49, a supply of cooling air may be continuously introduced at relatively low pressure and velocity through one or both of the pipe-tap openings 62 from a forced draft fan, not shown, associated for example with the vapour generating unit hereinbefore described. The opening not in use may be closed by a plug 63 as indicated. The continuous supply of cooling air thus introduced serves to maintain a low temperature zone within the door frame unit 34, thereby preventing the door from becoming overheated and possibly distorted when closed as a result of furnace radiation, and additionally providing protection to the glass observation window 46. Moreover, if any slight outward leakage should occur, the leakage will be of air rather than of hot furnace gases.

The door or cover 45 is pivoted to door head 36 on hexagonal-headed pivot pins 64 removably secured as by threads 65 to triangularly shaped door head flanges 67 at opposite sides, the pins extending through opposite side flanges or pivot arms 68 and 69 on door 45 and providing a horizontal pivotal axis 71 of door movement located a short distance above the longitudinal centre line 58 of the central passage 38. The door 45 is formed with a circular opening 72 in alignment with the passage 38 when the door is closed, the outer end of opening 72 being enlarged to form an annular recess 73 for the observation window 46 which is held in place by a ring 74 and cap screws 75. A lug 76 at the bottom of the door is formed with a hole 78 therein for engagement by a hooked tool principally for swinging the door from its closed position.

The door head 36 and door 45 are provided with companionate seating surfaces 79 and 80 respectively of part cylindrical formation and of the same radius, such surfaces having a common horizontal axis of curvature 81 intersecting centre line 58 vertically below the pivotal axis 71 as shown in Figure 7. Each of the surfaces 79 and 80 extends through an arc of about 100°—110° arranged symmetrically with respect to the horizontal centre line 58 of frame passage 38, the door being assumed to be closed. The holes for cap screws 37 are counterbored as at 82 to receive the screw heads and to provide clearance between the heads and the curved door surface 79. A packing groove 83, of dovetail cross section, filled with asbestos or other suitable packing material 84, is formed in the cylindrical end surface 79 of door head 36, the packing protruding slightly beyond the surface 79 and the groove extending in a rectangular pattern outwardly of the circle of connecting screws 37 as seen in Figure 8. In order to facilitate the machining of the cylindrical door surface 80, one of the pivot arms, such as arm 68, may initially be formed as a separate member and subsequently secured to the body portion of door 45 by means such as screws 68a, substantially as shown.

When the door is in its fully closed position, as seen in Figures 3 and 7, for example, the curved seat surfaces 79 and 80 are substantially concentric and in contact due to their radii being substantially equal and extending from a common centre or axis 81 parallel to the pivotal axis 71 and normal to the centre line 58 of frame passage 38. In this position, the door is seated throughout the perimeter of packing 84 to provide a gas tight seal between the door and its frame 34, the packing being of a deformable character and having sufficient resilience to compensate for any inequality in the radial dimensions of surfaces 79 and 80 which might result from machining, the tolerances normally employed limiting the difference in radii to a maximum of about 1/32 in. for example, for a nominal radius of each surface of 3⅜ in.

When the door is rotated from its closed position, in a counter-clockwise direction as viewed in Figure 4, the surfaces 79 and 80 are gradually separated and the door thus moved out of contact with the rim of packing 84 at surface 79. It will be noted that during opening movement of door 45, and similarly during closing movement, the surfaces 79 and 80 are eccentric, and their eccentricity is variable, the centre of curvature of the frame surface 79 being fixed at 81 and the centre of curvature of the door surface 80 moving along an arc 86 about the pivotal axis 71. The resulting movement of door surface 80 relative to frame surface 79 is therefore a combination of radial displacement with angular displacement to provide automatic sealing and unsealing of the joint between the door and its frame, and to minimise abrasive wear of the protruding packing material 84. The variable eccentricity of the door surface 80 relative to frame surface 79 thus contributes to the sealing pressure exerted on packing 84 as the door moves into its closed and seated position.

When the door 45 is swung open to a position where its lower edge 87 is above the uppermost margin of passage 38, as indicated in Figure 4, a right-angled notch 89 formed in the lower edge of door flange 69 is automatically engaged by an

arm of the trigger or latch 91 to hold the door open. The entire cross section of passage 38 is thereby exposed for lancing or other operations, and all screws 37 are rendered accessible for removal of the outer frame section 36 together with the assembled door 45 from the stationary inner frame section 35, thereby also rendering sleeve 48 accessible for removal from the inner frame section 35. The trigger 91 is in the form of a lever mounted intermediate its length on a hexagonal-headed pivot pin 92 screwed into the side of door head 36, the trigger having a cylindrical body portion 93 through which the pivot pin 92 extends and from which arms 94 and 95 of unequal lengths project radially in approximately opposite directions and in longitudinally offset relation. In the open position of the door, the side 96 of notch 89 is substantially horizontal and is engaged by the end surface 97 of the shorter trigger arm 94. the adjoining side surface 98 defining with surface 97 an angle less than a right angle to enable the arm 94 to be seated throughout the full depth of the notch. The longer counterweight arm 95, for this position, is inclined to the vertical at an angle of about 15° to provide a certain amount of leverage holding the arm 94 in its seated position within the apex of the notch.

When door 45 is to be closed, the trigger 91 is rotated clockwise, as viewed in Figure 4, suitably by a blow on the depending lever arm 95 to force the short upper arm 94 out of engagement with notch 89, the door then being free to respond to the force of gravity and automatically dropping to its closed position adjacent the door head surface 79 where it becomes wedged against the rim of packing material 84.

While in the disclosure of this invention the closure means has been described with reference to its application to a specific form of boiler furnace operating at positive pressures of the order of 40 in. H_2O, nevertheless, it is to be understood that this invention may also usefully be applied to furnaces and other chambered structures of various types operating at positive internal pressures ranging upwardly to 90 or 100 pounds per square inch, wherein the problem of preventing the discharge of high temperature gases becomes increasingly difficult.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Closure means for an opening in a wall of a chamber, such as a furnace chamber, arranged to operate under internal pressure, provided with a door frame member for the opening formed at its front end with a seat surface convexly curved about an axis, a door for closing the passage through the door frame member formed with a companionate seat surface curved about an axis which, when the door is in the closed position is coincident or substantially coincident with the axis of curvature of the door frame member seat surface, the door being rotatable about an axis so displaced from the latter axis of curvature that, when the door is moved from the closed position, the axis of curvature of the door seat surface has a component of movement in a forward direction, and jet discharge means adapted to discharge elastic fluid in such manner as to limit or prevent, when the door is open, the ejection through the passage of gas, from the chamber.

2. Closure means as claimed in Claim 1, wherein the axis of rotation of the door is vertically above the axis of curvature of the door frame seat surface.

3. Closure means as claimed in Claim 1 or Claim 2, wherein the door is pivotally mounted on an outer section of the door frame member secured to an inner section of the door frame member by circumferentially spaced holding members extending axially through the outer section and accessible when the door is open.

4. Closure means as claimed in Claim 3, wherein the door frame seat surface is provided with a protruding line of packing surrounding the end of the passage and located outwardly of the holding members.

5. Closure means as claimed in Claim 3 or Claim 4, wherein the door and the outer section of the door frame member are each formed with two flanges extending rearwardly on opposite sides of the door frame member and the door flanges are respectively pivotally connected with the flanges of the outer section of the door frame member.

6. Closure means as claimed in any preceding Claim, wherein a latch is provided for maintaining the door in an open position to which it may be raised.

7. Closure means as claimed in any preceding Claim, wherein the jet discharge means is a removable sleeve provided within the door frame member and formed with a plurality of jet holes.

8. Closure means as claimed in Claim 7, wherein the door frame member is of tubular form and includes aligned, separable sections jointed together and the removable sleeve is fitted within an annular recess formed in one of the sections and extending axially from the joint between

the sections.

9. Closure means as claimed in Claim 8, wherein the sections of the door frame member are formed with a spigot and socket joint, and clamped together, a packing ring being provided between the sections against which ring an end of the sleeve abuts.

10. Closure means as claimed in Claim 8 or Claim 9, wherein the removable sleeve is fitted within an annular recess in the section further from the door.

11. Closure means as claimed in Claim 8, Claim 9 or Claim 10, wherein an elastic fluid manifold extends around the door frame member and is formed with a continuous annular outlet leading to the inlet ends of a circle of jet holes in the removable sleeve.

12. Closure means as claimed in any preceding Claim, wherein at least one port is provided for the admission of cooling gaseous fluid to the passage through the door frame member when the door is closed.

13. Closure means as claimed in any preceding Claim, wherein the door frame member is secured to a casing, itself secured to fluid conducting wall tubes of a chamber and a central passage of the door frame member is in register with an opening in the casing formed between adjacent wall tubes.

14. Closure means for an opening in a wall of a chamber, such as a furnace chamber, arranged to work under internal pressure, arranged and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 23rd day of May, 1947.

For the Applicants,
A. C. PRICE,
Chartered Patent Agent.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1949.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 2s. 0d. each (inland) 2s. 1d. (abroad) may be obtained.

FIG. 1.

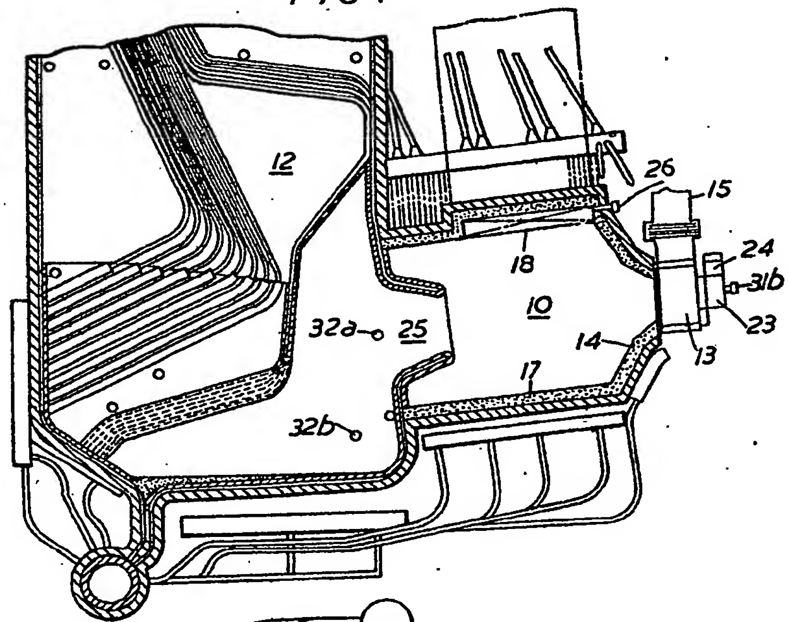
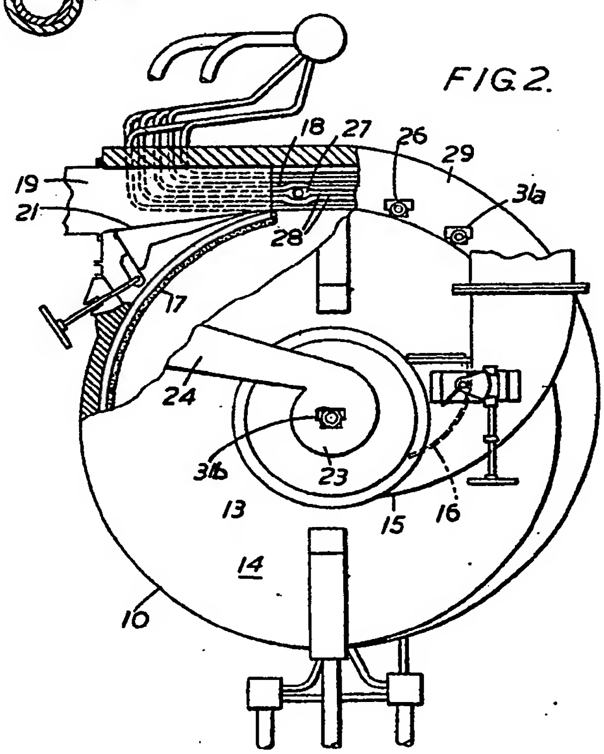


FIG. 2.



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H.M.S.O. (Ty.P.)

FIG.3.

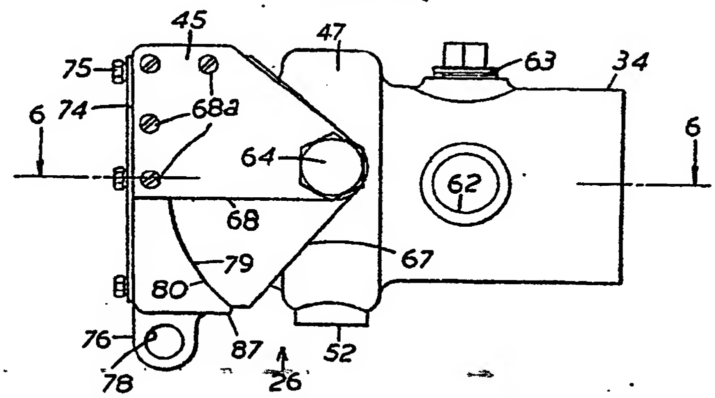

FIG.4.

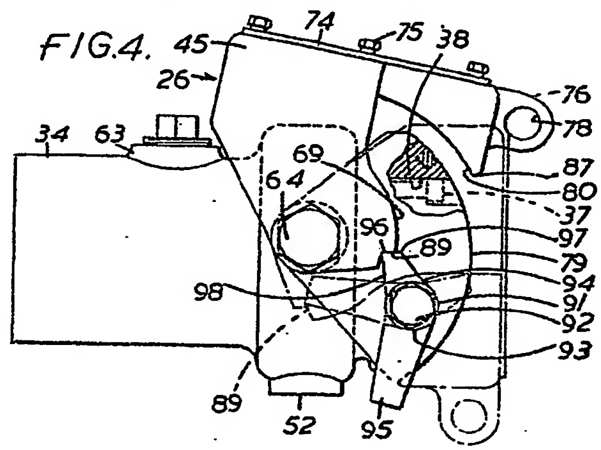

FIG.5.

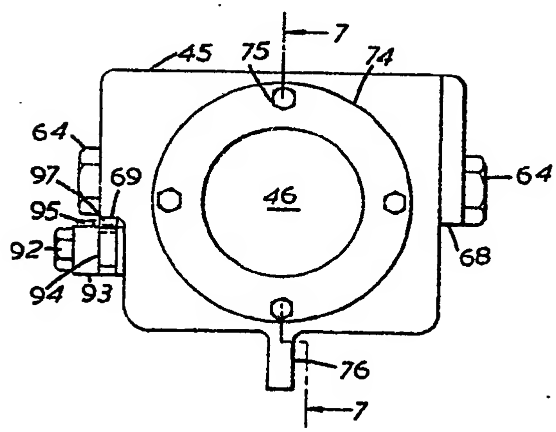

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FIG.6.

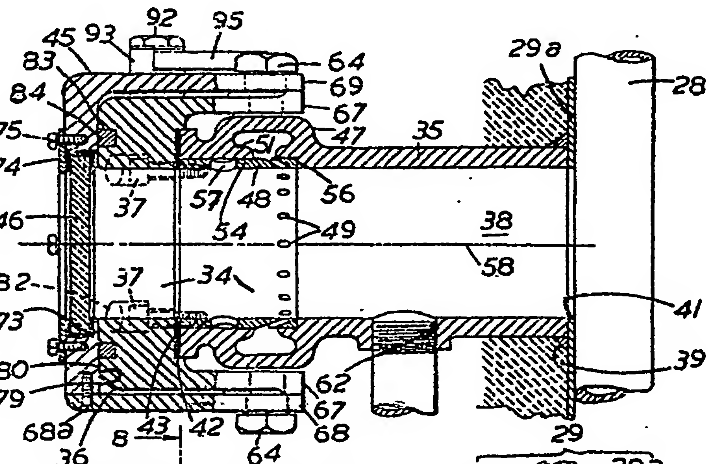


FIG.7.

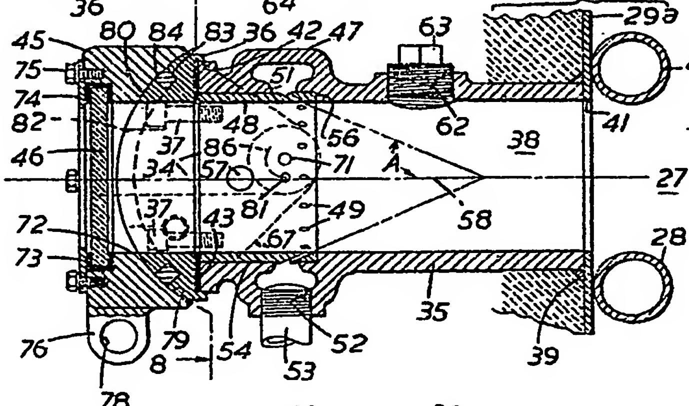


FIG.8.

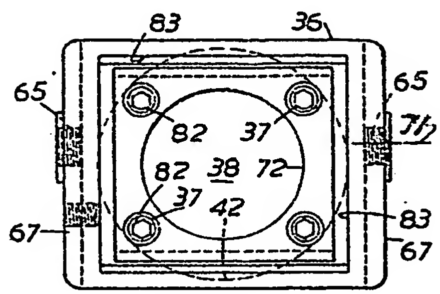


FIG.9.

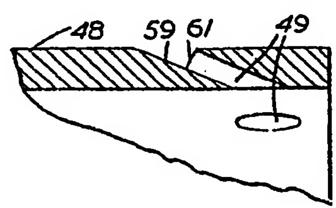


FIG.3.

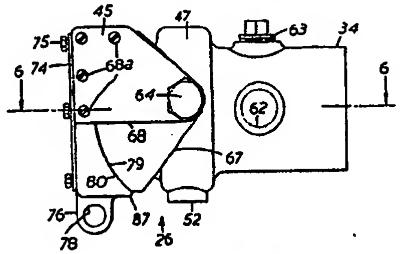


FIG.4.

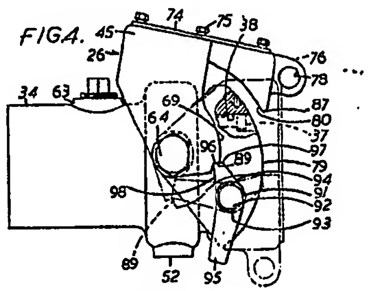


FIG.5.

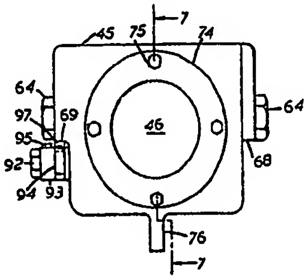


FIG.6.

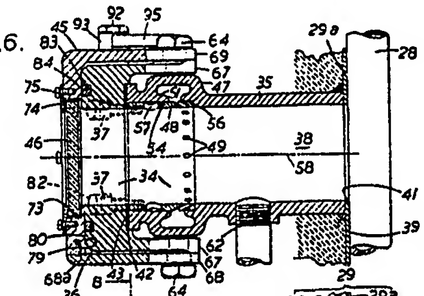


FIG.7.

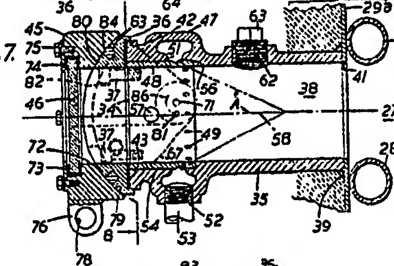


FIG.8.

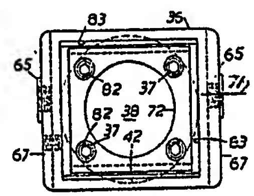
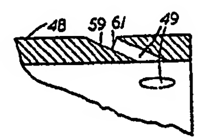


FIG.9.



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